

REPORT OF THE STATE NATURAL GAS SUPERVISOR.

OFFICE OF NATURAL GAS SUPERVISOR,
KOKOMO, IND., January 15, 1900.

Prof. W. S. Blatchley, State Geologist:

SIR—I submit to you herewith the eighth annual report of this department. It is made in obedience to section 7504 of the Revised Statutes of the State of Indiana, and is for the year ending December 31, 1899. In this, my fifth annual report, I have tried to avoid all matter that would suggest a rehash of former reports, and have given most space to a statement of the present condition of the gas field, a subject of great interest at present to every consumer of natural gas. Other subjects are noticed only to the extent of their relation to this subject.

Acknowledging the cordial support that I have received at your hands during the past year, I remain,

Yours respectfully,

J. C. LEACH,
State Natural Gas Supervisor.

THE INDIANA NATURAL GAS FIELD.

The Indiana natural gas field is in the eastern central part of the State. In shape it is an irregular obovate, about 100 miles from north to south and 70 miles from east to west. The gas rock,¹ or "sand," as it is sometimes called, is Trenton limestone. This is a universal formation in this State, though not a universal gas rock. Developments in the Trenton limestone in numerous places throughout its area indicate that it has been the source of gas as well as other bitumens in many localities where they are not found now, and that it is only under certain conditions, necessary to gas accumulation, that this gaseous fuel remains imprisoned in the rock in which it was generated. Where these conditions do not exist, the gas has either escaped to the surface or to an overlying formation in which it is now held.

The conditions necessary for gas storage, referred to above, rest largely in the texture and structure of the rock, though not wholly. To be suited to gas storage, or to be a gas rock, a formation must be porous; must have small interstices or pores in which the gas can accumulate. In addition to the above, a gas rock possesses a structural relief sufficiently elevated to permit the gas, with the other substances present, to arrange themselves in the order of their specific gravity, that is, the water, the oil, if any, and the gas on top. The elevation is relative and not necessarily absolute, and acts as a trap in which the gas accumulates. Another necessary condition to gas accumulation is a cover for the gas rock. This must be a formation impervious to gas, else the gas would escape, probably to the surface.

I refer briefly to conditions in this field in the inverse order. The Utica shale, a formation impervious to water and gas, overlies the gas rock in this State and forms a perfect cover.

The Cincinnati arch meets the second condition. It is a low, broad elevation that crosses the eastern boundary of the State between Lawrenceburg and Liberty and extends in a northwestern direction across the State. Its surface is very uneven in places, having numer-

¹ By gas rock is meant a rock in which natural gas is stored, and not necessarily one in which it has been generated.

ous small ridges or folds, with occasional spurs extending at various angles from the main elevation.

As has been stated, the Trenton limestone is the reservoir for the gas in this field. Throughout the gas area this formation is more or less porous to a limited depth, which condition is due to its chemical composition. The carbonate of lime in the upper beds of the Trenton rock has given away, in part, to carbonate of magnesia. The result is a highly crystalline limestone of sufficient porosity to contain a large quantity of gas. The gas rock is not equally porous throughout the field, nor of a uniform thickness, and, inasmuch as the productiveness of a gas rock depends upon its thickness and porosity, this field is not uniformly productive. As would be expected, the nearer the edge of the field, the less porous the rock becomes, until finally the porous rock becomes non-porous and the productive gas rock becomes a hard, barren limestone. In some places the transformation is slow, while in others it is sudden; very productive wells and absolute failures being drilled upon the same section of land. Specific reference is made to this subject as it affects this field in another part of this report.

It will thus be seen that it is not practical to determine the exact location of the boundary line of the gas field or its exact area; but wells have been located near enough to this line to draw the resources of the zone of uncertain territory. The area of the gas territory has been variously estimated from 2,500 to 4,000 square miles. When the former figure is given, it refers to productive gas territory. A fairly straight line, including the original gas territory, would include, approximately, 3,700 square miles.

CONDITION OF THE GAS FIELD.

During the early history of the gas field but little attention was given to this subject. After the gas area was located but few failures were recorded. Apparently nature had bestowed this gift with such lavish hands that the present generation need give no further attention to the fuel question. True, a few geologists said that the stock of this new fuel was fixed; that it could not last forever. But few believed this statement, and the wasteful manner in which it was used and the vandal-like waste permitted in some localities indicated an almost universal belief in an inexhaustible supply. As time went on, conditions began to change. Salt water invaded the field, and the productive wells in some localities, near the edge of the gas area, succumbed to its influence. Still, statements from the Natural Gas Supervisor that the history of other gas fields and the condition of

this indicated its ultimate exhaustion were branded as false, and made in the interest of gas companies, who desired to advance rates. State laws enacted to prohibit waste were difficult to enforce, owing to the adverse public sentiment. As the development of the field progressed, signs of failure in localities where the draught was heaviest became more apparent. The salt water became more intrusive, and the decrease in the rock pressure more marked. Thus, the history of the Indiana natural gas field has progressed since the first well was drilled, March 14, 1886.

Thirteen years have wrought a change in the public mind. It has been a struggle, but there are few, indeed, at present, who refuse to face the true condition of the field. Information regarding the progress of development, the advance of the salt water, capacity of wells, rock pressure, etc., is eagerly sought by manufacturers, gas companies and private consumers alike. I propose in this report to give such information as is most sought by consumers of natural gas; to make a true statement of the present condition of the gas field. This I have tried to do in previous reports, and it is most gratifying to me to know that the reports of the various committees sent by pipe line cities during the past year to investigate the condition of the natural gas supply have invariably verified the statements in my annual reports. There is no excuse for any one guessing or making exaggerated statements regarding the condition of the gas field. The true source of information is near at hand, and the facts can be easily ascertained.

GENERAL VIEW AND DIVISION OF THE FIELD.

As I have said, the productiveness of a gas rock depends upon its porosity. The Trenton limestone in this field does not possess a uniform porosity, and hence is not uniformly productive. Nor is this condition confined to any one locality. While as a general rule the gas rock is most productive away from the influence of the border of the gas area, that zone where the gas-holding rock changes to a hard, non-porous limestone, yet it is not an unusual thing to find wells of both large and small capacity on the same section of land in the interior of the field. In a few instances, wells showing neither gas nor water have been drilled near very productive wells.

CENTER OF THE FIELD.

The center of the gas territory, measuring from extreme to extreme of the cardinal points, is found to be about five miles southeast of Anderson, on a north and south line passing through Summitville.

This is not, however, the center of production or "heart" of the field. If by that point is meant that territory toward which the principal pipe lines are being extended and have not entered, and which has not been drilled except to supply local domestic consumption, it is near the northwest corner of Delaware County, and 24 miles north and three east of the geographical center of the gas area. The difference in the texture and structure of the gas rock and the unequal draught upon the northern and southern sections of the field are the principal causes of this divergence of centers.

The condition of the field can be better understood if the entire gas area be divided into two sections, with an east and west line parallel with the south boundary of Hamilton County and touching the same.

SOUTH SECTION.

This part of the field is triangular in shape; embraces parts of Marion, Hancock, Henry, Wayne, Rush, Shelby and Decatur counties, and contains approximately 850 square miles. In much of this section the gas rock is thin and hard, lacking the degree of porosity found in the northern section. The gas passes slowly from the rock to the wells, and, as a consequence, they are small and seldom overworked. Exceptions to this general statement are found in a few areas in the northern part of the section where the rock is quite porous and the wells large. In most instances, however, where these conditions exist, overwork has invited the salt water, and the wells have been comparatively shortlived. Pipe lines from this part of the field supply Connersville, Shelbyville and Hope. Aside from these cities, the draught is largely for local domestic consumption. The rock pressure varies from 75 to 275 pounds. The present indications and past history of this section of the field tend to confirm the idea that its gas supply, though comparatively small, will outlive that in the more productive part of the field.

NORTH SECTION.

When reference is made to the Indiana natural gas field, this section is usually in mind; not that it contains all the productive territory in the field, but it is from this section that a large majority of the pipe line cities are supplied, and in it the gas belt factories are centered. It embraces the whole of Madison, Delaware, Blackford and Grant counties, nearly all of Hamilton and Tipton counties, and parts of Howard, Miami, Wabash, Huntington, Wells, Jay, Randolph, Wayne,

Henry and Hancock counties. It contains (by difference) 2,850 square miles. Generally speaking, the gas rock in this section is more uniform in porosity and thickness than that in the southern part of the field.

DEVELOPMENT AND DRAUGHT.

The history of the discovery of natural gas in Indiana and the manner of development of this field is well known, and will receive a very brief notice here. The first wells were drilled in the vicinity of cities and towns by companies organized to supply gas for domestic purposes. It was not long until "farmer companies" were supplying the rural districts, and natural gas was a universal domestic fuel throughout the field. Nor was its use to cease here. Its value as a manufacturing fuel was soon known.

Factories of all classes, especially the large fuel consumers, were anxious to try the new fuel. At that time there were comparatively few factories in this part of the State. To-day the gas belt is the manufacturing center of the State, and if its fuel resources could have been kept within its borders, this industry would have been more extensive and the future of the field more promising. But this could not be so. The fuel value of natural gas was too well known and its transportation was a comparatively easy task. The initial rock pressure was 325 pounds. From 1888 to 1892 pipe lines were constructed to Indianapolis, Lebanon, Crawfordsville, Frankfort, Peru, Wabash, Huntington, Bluffton, Ft. Wayne, Decatur, Union City, Richmond, Connersville, Shelbyville and Chicago. A little later two lines were built from the eastern part of the field to Ohio; there, in addition to supplying a number of cities and towns, to supplement the rapidly diminishing supply of others that had formerly received an adequate supply from the field in the western part of that State. The Chicago and Ohio lines were equipped from the beginning with compressors to re-enforce the field pressure. Prior to the construction of these pipe lines there had been no systematic drilling in the field or effort to pre-empt territory. Cities were supplied from wells within their limits or the immediate vicinity, and but few factories went beyond their own yards for fuel. The pipe lines, radiating in every direction from this section of the field, tapped it at the nearest point. Thus, an outer zone around this entire section of the field was the first to be systematically and thoroughly developed, and, hence, the first to show signs of exhaustion. As wells near the edge of the gas area have become exhausted or the rock pressure reduced below that of the pipe lines,

this zone of territory supplying these lines has been moving toward the center of production. Pipe line companies have been compelled to plan their field of operation and hold large tracts of land under lease to protect their interests. This made it necessary for local gas companies and manufacturers to add an additional field expense. The leasing of territory has continued until practically the entire productive area is either under lease or its resources are controlled by adjoining land that is leased.

On account of the heavy pipe line draught on the border of the gas territory, and the necessary extension of the various lines from year to year, this section of the field presents three well defined divisions. First, the outer zone referred to above, which is exhausted for pipe line purposes. The wells are either exhausted or the rock pressure is below that of the pipe lines. This division varies greatly in width, it depending upon the pressure maintained in the various pipe lines as to when the wells become valueless as pipe line feeders. If all the territory was alike productive, then the draught upon a given line and the distance the gas is piped from the field would, to a large degree, determine the width of the zone in that locality; but as this is not true, even an approximately correct idea can not be gotten, except by an examination of the territory. This division is from 10 to 20 miles wide and contains about 1,400 square miles.

Second, a middle zone, which is the territory supplying pipe lines and a large majority of the factories in the gas field. It also varies in width and productiveness, and, in most localities, has been systematically and thoroughly developed. A few small areas at the head of minor pipe lines, supplying cities and factories, are not drilled. Some wells have been abandoned, and many on the outer edge of the zone do but little service during periods of light draught. The area of this division is approximately 1,350 square miles.

Third, the center of production, or that part of the field not invaded by pipe lines. It has for a center a point a little northeast of the northwest corner of Delaware County. Fairmount and Matthews are located within this area, and it contains about 100 square miles.

DEVELOPMENT, 1899.

The past year has been a very active one in the natural gas field. More line has been laid in the field and wells drilled by both manufacturers and gas companies than during any year previous. With the decline of the supply of gas and rock pressure has come the enforced tendency to enlarge main supply lines, parallel field lines and more

completely occupy the territory. While an occasional "gusher" has been drilled this year, the records of over 300 wells, old and new, located at various points throughout the field, show a decline in the volume of flow. Most of the wells drilled in 1899 show salt water, though its influence is being combated more successfully than ever before. This is done by drilling more wells, thereby lessening the draught on each well, and by the use of drips, separators, etc. Previous to 1899 13 compressing or pumping stations were maintained to re-enforce the field pressure. During the past year five new stations have been built and the capacity of five has been increased. The first factory to use a compressing station is the Muncie Glass Company, located at Muncie.

ROCK PRESSURE.

When speaking of the condition of a natural gas field, reference is usually made to the rock or closed pressure of the wells, it being the impression of many people that, accordingly as this is high or low, so are the wells large or small. This is not true in every instance, and as the supply of gas becomes more nearly exhausted this becomes a more uncertain index of the capacity of the wells. A decrease in the rock pressure of a given area of the gas field indicates a general diminution in the supply of gas in that area, but two wells on the same farm may have the same rock pressure and be very unequal in production. The velocity of the flow of gas at the well mouth is the only true index of the capacity of a well.

The original rock pressure of the Indiana natural gas field was 325 pounds. The heavy consumption of gas by all classes of consumers, from the beginning, soon became apparent in the decline of the rock pressure in those localities of largest draught. This was in the zone occupied by pipe lines and in the vicinity of cities and towns, though it was not long before the decline could be noticed in all parts of the field. The general decline has been gradual, showing greatest, of course, during periods of heavy consumption. For a number of years the decline in localities where the draught was somewhat equalized was about the same, and the rock pressure remained fairly uniform, but as time went on it became less uniform, local influences becoming more influential. It should be remembered that as the rock is not uniform in thickness both the lower and upper surfaces are more or less undulating. As the salt water advances, it may reach the upper surface of the rock at the synclines and hermetically seal the gas in elevated portions of the same; and thus, as the field progresses, it is

possible for the entire gas territory to be divided and subdivided into numerous small gas areas, varying in rock pressure, the draught in one locality not affecting others. Also, as the supply of gas becomes less it becomes more sensitive to the draught, and the pressure is less inclined to equalize.

It is difficult to ascertain the average rock pressure of the outer zone of the field, and, at most, it would give but little information as to the condition of this section. Wells in some localities, with a rock pressure of 250 pounds, have been abandoned on account of the presence of salt water. In time, a small amount of gas accumulates above the salt water horizon in these wells, and they register the same rock pressure as when abandoned. Thus abandoned wells in the western one-half of this zone are reported as showing a rock pressure much above that of the most productive part of the field. Though the rock pressure is high, the volume of gas is trivial. It is plain, I think, that to give the average rock pressure of the territory abandoned for pipe line purposes, or to include it with the other sections of the field, would give misleading results. To understand the present condition of the natural gas industry, the condition of all the territory in the northern section of the gas field, except the zone mentioned above, should be studied; for it not only supplies local domestic consumption and factories, and the larger cities in abandoned territory, but pipe line cities as well. November, 1897, the average rock pressure of this territory was 191 pounds. November, 1898, it was 173 pounds, a decrease in one year of 18 pounds. At present, practically the same territory shows an average rock pressure of 155 pounds. Of course it is understood that the area of this territory becomes less each year, and that the above results are not from data taken from the same wells year after year, but are the results of numerous tests made in the territory. The rock pressure in the undeveloped part of the above territory varies from 170 to 210 pounds.

CONSUMPTION OF NATURAL GAS.

At this time, when much unsatisfactory service is being reported, especially from pipe line cities, there is naturally considerable discussion as to the cause, and in connection much is being said about economical appliances and methods of using natural gas for fuel purposes. Is the consumer in any way responsible for defective service, and, if so, how? From the beginning all classes of consumers, with the possible exception of those who own their own gas plants, and have watched the progress of the field, have been slow to believe that the

stock of natural gas was being reduced by every cubic foot consumed; that the annual decrease in the rock pressure was rendering it more and more difficult each year to get the gas to the consumer, and correspondingly slow to investigate the advisability of adopting economical appliances for the consumption of this gaseous fuel. And, with this, it should be stated that not a few gas companies have been slow to learn the absolute necessity of enlarging and improving their plants to meet the ever changing condition of the gas field, and the increased consumption of gas. These conditions combined have, in many instances, resulted in poor service where it should have been otherwise.

Most of the cities using gas from this field are prosperous. Their history is one of growth. In many instances the population is twice, and in some instances three times, what it was twelve years ago. Most gas plants were built hurriedly, and for the present only. But few, indeed, were wise enough to forecast the future and build for its needs. Plants built to supply a city of 5,000 population are now expected to serve a city of 10,000 people. With the decrease in the rock pressure of the field has come the necessity for larger supply lines, regardless of the increased demands. When the gas moves slowly, it must move in larger volume. Finally, comes the necessity for compressors to re-enforce the field pressure. It rests with the gas company to supply the gas in sufficient volume and at a uniform pressure, and it is the duty of the consumer to use the most economical heating appliances for consuming the gas, and keep them clean and in repair. By an economical heating appliance I mean one (grate, stove, furnace or boiler) so fitted with burners and mixers and with the draft so regulated that all the gas supplied will be consumed and all the heat therefrom supplied to the room instead of passing in part out through the chimney, as in most cases is true. The aim of the consumer should be to secure a complete combustion of the gas, thereby realizing its full heating power. Incomplete combustion is not only wasteful but is almost sure to result in unsatisfactory service, even if the supply of gas is ample with the unfavorable conditions. It is also sure to result in the formation of carbonous oxide gas, which is extremely poisonous. Though the heating appliances are perfect and the supply of gas ample in the company's lines, the service will not be good if the piping in the house is faulty; that is, if it is too small and not properly placed and not kept clean. It is not practical to make specifications that will meet the conditions in all houses alike. The number of services and the consumption govern. As a general rule, the line from the street to the average house should not be less than one and one-fourth inches in diameter, and no pipe less than one-half inch. When

the service is poor and there is reason to suspect that the piping is at fault, the matter can be easily determined by a simple test. Let an ordinary water gauge be attached to a service pipe at any point (light, mixer, etc.) in the house. If the pipes are large enough and clean, the pressure will remain the same whether the fires are burning or not. If too small, or partially filled with foreign matter, the pressure will materially decrease when the fires are lighted.

I believe that many consumers of natural gas would find material relief from poor service in scientific plumbing and economic devices for consuming the gas. Of course these appliances will not take the place of gas nor relieve gas companies from the responsibility of supplying it in adequate volume, but they will aid the consumer in securing all the heat in the gas supplied, which, when the supply is short, is certainly a sufficient incentive. In many instances the gas burned in a grate that radiates but little heat would, if consumed under proper conditions, make a home comfortable.

Natural gas is an ideal domestic fuel, clean, labor-saving, and, when properly used, maintains a uniform temperature. Residents of the gas belt have enjoyed the luxury of its power since 1887, and many of the surrounding cities since 1890. To be compelled to return to other fuels will cause much inconvenience and no little expense. As much as it may be regretted, such will surely be the result. Would it not be well to think about it in advance; to prepare for it? As is known, gas belt cities have enjoyed a marvelous growth during the past ten years. Hundreds of residences have been built and fitted especially for the use of this fuel. A change in fuels will, in many cases, necessitate an entire change in heating appliances, grates, stoves, etc., and, in some instances, chimneys will have to be rebuilt to insure safety. However, the change will not come unheralded. Some cities have seen visions of the future very plainly this year; but the indications are that after the pipe line cities have ceased to draw from the field and the supply has become too limited for the large consumers, that the domestic consumers within the gas belt will enjoy the use of this fuel for a number of years.

THE MANUFACTURING INDUSTRY.

I will not detract from the merits of natural gas as a domestic fuel when I say that it is the most valuable manufacturing fuel known, although the cost has been small, indeed, to many. Free gas was usually a part of the subsidy given to factories to secure their location in the gas field. This was entirely unnecessary, as was any subsidy

at all, and was responsible to some extent for the wasteful use of this fuel for many years. The growth of the manufacturing industry in this section of the State, since the discovery of natural gas, has exceeded the most sanguine expectations. In 1886, only such factories were here as are usually found in agricultural regions such as this was. Now, factories of nearly every class, especially the large fuel consumers, are located here. In this way a vast amount of capital has been invested in the gas belt. In 1886, the property in Madison County was valued for taxation at \$9,773,805; at present, it is \$27,394,845, an increase in 13 years of \$17,621,040. The assessed valuation of property in Delaware County has increased from \$9,590,185 to \$21,632,900 since 1886. In Grant County it has increased from \$8,921,445 to \$23,000,000; and in Blackford County it is \$7,330,860 at present, while in 1886 it was \$2,871,114. And this, with town lots listed at something like their real value, instead of a fictitious value, such as was placed upon them in most instances during the early history of the natural gas field. Of course this large increase of wealth in these counties, and other counties in the gas belt, not mentioned, should be credited to their fuel resources, and not a small amount of it directly to gas wells, pipe lines, pumping stations, etc.

As has been stated, most factories in the gas belt are large fuel consumers. The fuel resources of this section of the State are responsible for their being here. It is now a generally accepted fact that the supply of this fuel is decreasing and will finally become exhausted; and no person is better acquainted with the true condition of the field than are the manufacturers. While some factories occupy substantially built buildings, others occupy structures that could be abandoned without much loss. In view of these conditions, then, is it not natural that much anxiety should be felt by residents of the gas field regarding the future of the manufacturing industry? When the natural gas supply is exhausted, will the factories remain where they are, or will they seek other locations? Time only can give a definite answer. I believe that a majority of the largest and most substantially built factories will successfully adopt other fuels and remain. This is the view entertained by the leading manufacturers, and, considering everything, it is rational. With the failure of the first wells, and the general decline of the field, has come to most manufacturers a keener appreciation of the value of natural gas as a fuel; a disposition to provide for the future as far as possible and husband their fuel resources. And, while it is true that manufacturers who have outlived a less productive field are very apprehensive concerning the future, they are

disposed to find another fuel in case it is necessary rather than a new location. Manufacturers do not want to change locations. It would entail quite an expense, and, in a measure, disturb their business for a time. A majority will make an honest effort to successfully adopt other fuels. A few now are using coal during periods of heavy draught, and as the supply decreases more will be compelled to supplement their gas supply with other fuel. The change will come gradually. Then, taking into consideration the proximity of the gas belt to the markets of the country and the Indiana coal fields, and the splendid railroad facilities possessed by this section, both with reference to the coal fields and the markets, it seems that a majority of the gas belt manufacturing industries are permanently located.

THE WASTE OF NATURAL GAS.

It should not be necessary to refer to this subject at this late day. It would seem, with the knowledge that consumers in general have of the condition of the field, that the seeming indifference to the extravagant use and waste of this valuable fuel that has existed since its discovery would be entirely displaced with an economy and care commensurate with its value. This is not the condition. While the waste of gas is growing less, and it is being consumed more economically than formerly, yet some gas is permitted to waste, and this should not be. More interest is being manifested in this subject now than ever before. Manufacturers, gas companies and residents of the gas belt have rendered me very great assistance during the past year by promptly notifying me of any avenue of waste coming to their notice and needing my attention. I have thus been able to do work that would otherwise have been impossible; for one man can not inspect all the gas property in the State often enough to accomplish the end sought.

A majority of the consumers of natural gas use it in such a manner as to waste much of its heating power. It is seldom, indeed, that the gas is all burned and the heat supplied where it belongs. Incomplete combustion is the rule rather than the exception, and this always means waste. This does not apply to the domestic consumer only, but to the manufacturer as well.

And, incomplete combustion is not the only avenue of waste by domestic consumers. In a majority of residences and business houses in the gas belt, more gas is used than is necessary even under present conditions. The temperature of most houses is kept above the health limit, and not infrequently are the doors and windows opened when the gas should be turned down. The heating power of natural gas is

cumulative, and fires need constant attention if the temperature is to be kept at a health limit. The present system of selling gas, the "contract system," is doubtless responsible for much of the indifference manifested by the average consumer toward methods of consumption and amount of gas used, and but little improvement can be expected until it is forced by a shortage in the supply. It is claimed by many, especially those engaged in selling gas, that the use of meters would not only prolong the life of the gas field but would tend to improve the service by the introduction of economical appliances and methods which would follow the introduction of the "meter system." Brief reference has been made to this in a former chapter. There can be no question as to the right method of selling gas. If natural gas is property, and can be transferred as other property is, it will harm no one to pay for it as he pays for other property. Those who oppose the "meter system" contend that the adoption of it will benefit the gas company only; that it means a higher price for gas. While this may be true, it is not necessarily so. I can see no reason why the rates could not be adjusted as equitably and as satisfactorily under one system as another. A schedule of prices under which I am compelled to pay for the gas which I use, and no more, is certainly just. If I choose to adopt economical appliances and practice economy, a reduction in my gas bill will follow. If I use it extravagantly, I pay for what I use and no more. It does not now seem probable that meters will ever be universally used, though by common consent or necessity their use will become more general each year. In the localities where the supply is short at times, consumers of gas will adopt meters, that they may pay for the gas they use and no more.

WASTE OF GAS FROM PIPE LINES.

Natural gas escaping from the many pipe lines, both large and small, that thread the gas territory in every direction, attracts the attention of the public more than any other avenue of waste. A very small leak will often make a noise that will magnify its importance. In the past a heavy drain upon the supply has come from this source. Conditions are much better than formerly, but not what they should be yet. It is possible to keep the large pipe lines that are buried a reasonable depth underground comparatively tight, but the small lines lying on top the ground present a more difficult problem. These lines are usually along the public highway, in danger of being broken by vehicles, and subject to a varying temperature which makes it almost impossible to keep them in perfect repair. The larger lines are

easily repaired with airtight clamps, and when once repaired seldom need attention. Not so with the small lines. They need constant attention. A regular patrol at frequent intervals is necessary. This will reduce the waste to a minimum. I am glad to say that at present a majority of the gas companies and manufacturers keep men employed for this purpose. These men are usually attentive to their work and very properly report to me any leaks they may notice on lines in their territory that are without care. I have thus been able to do more effective work along this line than in any former year. Previous to this year, there was no law prohibiting pipe line waste, and, at my suggestion, the last General Assembly (1899) enacted the following law, to wit:

An act regulating the use, maintenance and operation of natural gas pipe lines and machinery, apparatus and equipments used in the transportation and distribution of natural gas, providing penalties for its violation, and declaring an emergency.

[Approved February 23, 1899.]

Section 1. Be it enacted by the General Assembly of the State of Indiana, That it shall be and is hereby made the duty of the Natural Gas Supervisor of the State of Indiana, upon the discovery of any leak in any pipe line for the transportation of natural gas, or in any machinery, apparatus, appliance or device used in the regulation or distribution thereof, to forthwith notify, in writing, the owner or superintendent of said pipe line, machinery, apparatus, appliance or device, to have the same repaired within two days from the time of receipt of said notice. In case such leak has not been repaired within two days from the time of receiving such notice, it will be the duty of said Natural Gas Supervisor to make such repairs as may, in his judgment, be necessary to stop said leak; and such Natural Gas Supervisor shall have a lien upon said pipe line and all wells with which the same may be connected, for the cost of making such repairs, for the enforcement of which, with all costs of suit, and a reasonable attorney's fee, an action may be maintained by him in any court of competent jurisdiction.

In case of any pipe line, machinery, apparatus, appliance or device, owned by a corporation, partnership, or by a non-resident or absentee from the State of Indiana, the notice herein provided may be served upon any person in charge of such pipe line.

Section 2. An emergency exists for the immediate taking effect of this act, and the same shall therefore be in full force and effect from and after its passage.

Though I have not had occasion to enforce the penalty provided for the violation of this act, it has rendered me very effective aid. A large

part of the waste from pipe lines comes from negligence on the part of the superintendents of gas plants or field men, and one notice, as provided by law, has, to date, been sufficient.

THE OIL INDUSTRY AND NATURAL GAS.

The Indiana oil field is on the northeastern border of the gas field, and embraces parts of Adams, Jay, Blackford, Wells, Grant and Huntington counties. This is distinctively oil territory, and, while its development has involved the waste of a little gas in some localities, the amount has been insignificant compared with the value of the oil. Generally not enough gas is produced to operate the wells, pipe lines to the gas field being necessary to supply gas for drilling and pumping purposes. The oil territory is contiguous to the gas field, and it is sometimes difficult to define the boundary line between the two. Frequently wells drilled near it produce both gas and oil. The present price of oil tempts some oil companies to drill in gas territory; however, since the Supreme Court of the State has decided the law prohibiting the waste of gas from oil wells constitutional, most companies have shown a disposition to obey its provisions. Immediately after the court gave this decision, March 12, 1898, forty wells in Madison, Delaware and Blackford counties, producing both products, were closed, and have remained so to date. There has not been a well drilled for oil in Madison or Delaware counties for nearly two years. In Blackford and Grant counties it is different. Each of these counties, though embracing the most productive gas areas in the field, contains quite an amount of distinctively oil territory. Occasionally a well produces both products, and where the gas can not be separated from the oil and used legitimately, it is necessary to close the well.

I have closed nine wells during the past year to protect the natural gas industry, one of which was by injunction. Of course some were closed voluntarily and without even a notice.

NATURAL GAS LAWS AMENDED.

The General Assembly of 1899 amended the law prohibiting the waste of natural gas and oil from wells as follows, to wit: "Section 3. Any person violating any of the provisions of this act shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any sum not less than twenty dollars nor more than two hundred dollars, to which may be added imprisonment in the county jail not less than ten days nor more than sixty days; and each day during which such violation shall continue shall constitute a separate offense." Page 82,

Acts 1899. This amendment makes the law much more effective and its enforcement much less difficult than formerly. The greatest objection to the law, as originally enacted, was that it involved the tedious delay of a civil action, which meant much, when millions of feet of gas were escaping into the air daily.

A BRIEF SUMMARY.

1. During the early history of the field but little attention was given to its condition. It was the prevailing idea that the supply of gas was inexhaustible. Statements to the contrary were branded as false and made in the interest of gas companies who desired to advance rates. Thirteen years have wrought a change in the public mind. There are but few, indeed, at present, who refuse to face the true condition of the field. Information regarding the progress of development, the advance of the salt water, capacity of wells, rock pressure, etc., is eagerly sought by manufacturers, gas companies and private consumers alike.

2. Practically all the territory in the field is either under lease or is controlled by territory that is leased. More lines have been laid and wells drilled during the year 1899 than any year previous. The tendency is to enlarge the main supply lines, parallel field lines and more completely occupy the territory. Most of the wells drilled during the past year show salt water. Five new compressing or pumping stations have been built since the last report, and the capacity of five has been increased, making nineteen stations in the field. A number of small stations will be built by manufacturers and cities in the gas field this year.

3. The condition of the field can be best understood if divided into two sections, with an east and west line touching the south boundary of Hamilton County. The section south of this line contains about 850 square miles. In much of this section the gas rock is hard and thin and the wells small compared with those in the north section.

4. Where reference is made to the Indiana natural gas field, the north section is usually in mind. It supplies most of the pipe line cities, and in it the gas belt factories are centered. It contains, approximately, 2,850 square miles. On account of the heavy pipe line draught on the border of this section, and the extension of the various lines from year to year, it presents three well-defined divisions. First, an outer zone, in which the wells are either exhausted or the rock pressure is below that of the pipe lines. It contains about 1,400 square miles. Second, a middle zone, from which a majority of the pipe line

cities and gas belt factories get their fuel. It has an area of about 1,350 square miles. Third, the center of production, or that part of the field not invaded by pipe lines. It has for a center a point a little northeast of the northwest corner of Delaware County, and contains about 100 square miles.

5. While an occasional "gusher" has been reported during the past year, the records of over 300 wells, old and new, show a decline in the volume of flow. The average rock pressure of all that part of the north section, except the outer zone, is 155 pounds. The rock pressure in the undeveloped part of this section (100 square miles) varies from 170 to 210 pounds.

6. There has not been a well drilled for oil in Madison or Delaware counties for nearly two years. I have closed nine wells during the past year that were producing both gas and oil, one of these by injunction.

7. There is much anxiety on the part of residents of the gas belt regarding the future of the manufacturing industry. Though conditions, to a certain extent, warrant this, I believe that a majority of the factories will successfully adopt other fuels when it becomes necessary. Manufacturers are disposed to find another fuel rather than a new location.

8. Regarding the future of the gas field, I will say, as I did in my last annual report, that the history of other gas fields, the past history of this and all its present conditions justify the statement that the supply of gas is failing and will finally be exhausted.